User's Guide

Creating and Managing Arrays

Using the RAID Array Software for the AHA-3980/3985

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▼▼▼▼ Contents

1 Introduction

Adaptec Arrays 1-1
- Array Types 1-1
- Number of Disks in an Array 1-3
- Mixing Disks from Different Manufacturers or with Different Capacities 1-4
- Mixing Disks on Different RAID Adapter Channels 1-4

The Adaptec Array Software 1-4
The Adaptec CI/O Software 1-5
System Requirements 1-5
Using This Guide 1-6
Conventions 1-7

2 Understanding the Administrator Utility

Starting the Administrator Utility 2-1
Exiting the Administrator Utility 2-2
The Main and System Menus 2-2
- Main Menu 2-3
- System Menu 2-4

Selecting Menu Options 2-4
Gray Menu Options 2-5
Getting Help 2-5

3 Setting Up the Initial Arrays

Creating the Initial Arrays 3-1
Installing the Array Utilities in the sys:system Directory 3-6
The startup.ncf and autoexec.ncf Files 3-7

4 Formatting Arrays

Choosing the Formatting Method 4-1
Choosing the Data Block Size 4-2

Formatting the Array 4-2
Canceling Formatting 4-4

5 Monitoring Array Performance

Obtaining Array Information 5-1
- Displaying Overview Information 5-2
- Displaying Performance Statistics 5-3
- Changing the Data Sampling Rate 5-3
- Resetting the Temporary Statistics to Zero 5-4
- Saving the Statistics in the Log File 5-4

Determining Who Receives Messages 5-5
Setting the Repeat Interval for Error Messages 5-7
The Log File 5-7

6 Managing Arrays

Verifying Arrays 6-1
- Assigning a Priority 6-2
- Verifying an Array Immediately 6-2
- Verifying an Array at a Scheduled Time 6-3
- Canceling a Verification 6-3
- Changing the Priority of a Verification in Progress 6-4

Testing Spare Disks 6-4
Reconstructing Data on a Replacement Disk 6-4
- Reconstructing the Data Immediately 6-5
- Reconstructing the Data at a Scheduled Time 6-6
- Canceling Reconstruction 6-6
- Changing the Priority for Reconstructing Data 6-6

Reactivating an Off-line Array 6-7
Reactivating a Spare Disk 6-7
Scheduling Tasks 6-8
- Scheduling a Task 6-8
- Changing the Schedule 6-9
- Deleting a Scheduled Task 6-9

Using the Hardware Functions 6-10
- Identifying the Allocation of Host Adapter Drives 6-10
- Locating a Drive 6-11
- Pausing Host Adapter Activity When Replacing Disks 6-12

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: iv
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

7 Changing Array Configurations

Adding an Array 7-1
Modifying an Array 7-4
- Changing the RAID Level 7-4
- Selecting Different Disks for the Array 7-5
- Adding a Spare Disk 7-5
- Deleting or Changing a Spare Disk 7-6

Converting between RAID 0 CVT and RAID 5 CVT Formats 7-7
- Canceling a Conversion 7-8
- Changing the Priority of a Conversion in Progress 7-8

Deleting Arrays 7-9
- Deleting a Single Array in Multiple-array Systems 7-9
- Deleting the Only Array or All Arrays 7-9

8 Working from a Remote Workstation

Standard Adaptec CI/O Features 8-1
Adaptec CI/O Features When Working with the Administrator Utility 8-2
Enabling a Remote Workstation to Receive Administrator Utility Data 8-3
Remotely Accessing the Administrator Utility 8-4

A Error Messages

B Glossary of Array Software

NetWare Drivers B-1
NetWare Loadable Modules B-2
Other Files B-3

C Menu Reference

Index

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: v
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

1

Introduction

Adaptec array software lets you set up and manage RAID disk arrays on NetWare systems that use Adaptec AHA-3980 or AHA-3985 RAID adapters. A *disk array* is a group of disks that appears to the system as a single virtual disk. This is accomplished through software. *RAID* (redundant arrays of independent disks) refers to disk arrays in which part of the array storage capacity may be used to store redundant information. The redundant information lets you restore user data if a disk in the array fails.

A virtual disk is functionally identical to a physical disk. Depending on the array type, however, the virtual disk has advantages in cost, performance, reliability, or a combination of these. This chapter explains the different array types and introduces the Adaptec array software that lets you create them.

Adaptec Arrays

An Adaptec array is an array that was set up using Adaptec's array software (see *The Adaptec Array Software* on page 1-4). Adaptec's array software lets you create up to four nonbootable arrays of SCSI disks, offering several array types.

Array Types

Array types are defined by their RAID level, a number from 0 through 6 (a higher RAID level does not indicate a higher level of performance or reliability). Adaptec array software lets you create RAID 0, 1, 1/0, and 5 arrays, those proven to be the most useful for NetWare RAID applications.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

RAID 0 (Striped Disks)

In a RAID 0 array, data is distributed, or *striped*, across the disks in the array. The array appears to the server as one large disk with a capacity approximately equal to the combined capacity of the physical disks. Because multiple reads and writes can be handled in parallel, the input/output performance of the array is much better than that of a single physical disk.

No redundant data is stored in RAID 0 arrays, so they are not true RAID applications. If one disk fails, the entire array fails and all array data is lost. The reliability of a RAID 0 array, therefore, is less than that of any single disk in the array. The term RAID 0 is widely used for these arrays, however, because they are conceptually similar to true RAID applications.

RAID 1, RAID 1/0 (Mirrored Disks)

In RAID 1 and RAID 1/0 arrays, commonly called mirrored arrays, disks are paired, with both disks in a pair containing the same data. When data is written to a mirrored array, it is written twice—once to each disk in the pair. A RAID 1 array has only one set of paired disks. A RAID 1/0 array has multiple pairs, across which data is striped.

A mirrored array has good performance. In RAID 1 arrays, the read performance can be much better than that of a single disk, while the write performance is slightly worse. In RAID 1/0 arrays, both read performance and write performance are better than those of a single disk.

A mirrored array is also highly reliable, because both disks *in a pair* must fail for the array to fail. In an array with five pairs of mirrored disks, for example, the array can maintain its integrity if even five disks fail—as long as each pair has one good disk.

The main disadvantage of a mirrored array is its cost. Because all disks must have a twin, you must use twice the number of disks that actually contribute to the array capacity. In an eight-disk array, for example, you have only four disks of usable capacity.

RAID 5

A RAID 5 array is similar to a RAID 0 array; however, it contains redundant information in the form of parity data, which is calculated block by block for all user data. The parity data is interspersed across all disks in the array, occupying the equivalent capacity of about one disk. If one disk in the array fails, the data on the failed

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

disk can be reconstructed from the parity data and user data on the remaining disks. Two disks must fail for the entire array to fail.

The read performance of a RAID 5 array is excellent—comparable to that of a RAID 0 array. Write performance is lower than that of a RAID 0 array, because write operations involve calculating and writing new parity data as well as writing the new user data.

RAID 0 CVT and RAID 5 CVT

RAID 0 CVT and RAID 5 CVT arrays are identical to RAID 0 and RAID 5 arrays, but you can convert from a RAID 0 CVT array to a RAID 5 CVT array and back again without loss of data and without reformatting. The CVT formats allow you to use the more reliable RAID 5 format for normal use, then switch to RAID 0, which has higher write performance, for large data transfers (for example, restoring data from tape). Once the data is transferred, you can convert back to the RAID 5 CVT format.

Note: For more information on RAID levels, see *The RAIDBook: A Source Book for RAID Technology*, published by the RAID Advisory Board (Lino Lakes, Minnesota: September 1994).

Number of Disks in an Array

The following table shows the number of SCSI disks allowed in each type of Adaptec array.

RAID Level	Minimum No. of Disks	Maximum No. of Disks
RAID 0 (striped)	2	8
RAID 0 CVT	3	8
Mirrored:		
RAID 1	2	2
RAID 1/0[1]	4	16
RAID 5	3	8
RAID 5 CVT	3	8

[1] The number of drives in a RAID 1/0 array must be even.

In addition to the main disks, you can specify for mirrored and RAID 5 arrays up to two spare disks (RAID 0 arrays do not have

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-3
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

spares), which are automatically activated when an array disk fails. A spare must have at least the capacity of the smallest disk in the array.

Mixing Disks from Different Manufacturers or with Different Capacities

An array can contain different models of SCSI disks, even disks with different capacities; for example, an array can include a Quantum 340 MByte disk and a Conner 540 MByte disk. If you mix disks with different capacities, however, the smallest disk determines the logical capacity of all other disks in the array (regardless of RAID level). If a RAID 0 array contains one 340 MByte disk and four 540 MBytes disks, for example, the capacity of the array is equivalent to about five 340 MByte disks. To avoid wasted disk capacity, therefore, use disks of similar size.

Mixing Disks on Different RAID Adapter Channels

An AHA-3980 RAID adapter has two channels: A and B. An AHA-3985 RAID adapter has three channels: A, B, and C. Each channel acts as an independent RAID controller, implementing a separate SCSI bus (for more information on the AHA-3980 or AHA-3985, see the *AHA-3980/3985 User's Guide*). An array can consist of disks on different channels of the same RAID adapter; however, it *cannot* include disks from multiple RAID adapters.

The Adaptec Array Software

Adaptec's array software lets you perform all tasks relating to setting up and managing up to four nonbootable arrays. To perform these tasks, you use the Administrator utility. This utility lets you

- Create the initial arrays
- Format the arrays
- Add, modify, or delete arrays
- View array information
- Perform routine management tasks such as testing spare disks, verifying the integrity of arrays, regenerating data on replacement disks, and reactivating off-line arrays and spares

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

See Chapter 2 for an overview of the Administrator utility and Chapters 3 through 8 for detailed instructions.

Note: Depending on the task, the Administrator utility may call other utilities, such as the Format utility. This happens in the background, so you do not need to understand the other utilities. If you are curious about these utilities, however, see Appendix B, *Glossary of Array Software*.

The Adaptec CI/O Software

Adaptec CI/O is a separate software package that lets you monitor SCSI subsystems, including Adaptec arrays, from a remote workstation. Adaptec CI/O also lets you remotely access the Administrator utility, making all Administrator utility functions available at the remote workstation. For an overview of Adaptec CI/O capabilities, see Chapter 8, *Working from a Remote Workstation*. That chapter also explains how to set up the Adaptec array software for use with Adaptec CI/O.

AHA-3980 and AHA-3985 RAID adapter kits include Adaptec CI/O (the single server version). If you purchased the RAID adapter separately, you can obtain Adaptec CI/O by calling the sales order line at the number listed on page ii.

System Requirements

The Adaptec array software must be installed on a NetWare server that has the following hardware and software:

Hardware

- A PCI-based computer that is PCI Rev. 2.0 compliant, has a motherboard BIOS that supports PCI bridge technology, and has a PCI bus master slot available for the AHA-3980 or AHA-3985 RAID adapter.
- An installed AHA-3980 or AHA-3985 RAID adapter (see *AHA-3980/3985 Quick Installation Guide* or *AHA-3980/3985 User's Guide* for installation instructions).

- A minimum of two SCSI disks for a RAID 0 or mirrored array; a minimum of three SCSI disks for a RAID 0 CVT, RAID 5, or RAID 5 CVT array (see *Number of Disks in an Array* on page 1-3).

Note: The array disks must be attached to the AHA-3980 or AHA-3985 host adapter (see *AHA-3980/3985 User's Guide* for instructions on connecting and configuring the disks).

- A boot disk separate from the array disks. The boot disk may be any hard disk (for example, IDE, EIDE, or SCSI disk). If a SCSI disk, it need not be attached to the AHA-3980 or AHA-3985, although it can be. (For instructions on creating a boot disk, see *AHA-3980/3985 User's Guide*.)
- Two megabytes of hard disk space for the Adaptec array software.

Software

- NetWare 386, version 3.11, 3.12, or 4.xx.
- NetWare CLIB 3.12 or higher.
- MS DOS 5 or higher (MS-DOS 6 recommended).
- The AHA-3980 and AHA-3985 drivers for NetWare (see *AHA-3980/3985 User's Guide*).

If you intend to use Adaptec CI/O, it must be installed on the remote workstation where you plan to monitor the arrays. See the Adaptec CI/O documentation to learn the hardware and software requirements at the remote workstation.

Using This Guide

Begin with Chapter 1 (this chapter) to learn the general features of arrays and the Adaptec array software. Pay particular attention to *System Requirements* on page 1-5.

Next, review Chapter 2 to learn the basics of the Administrator utility. Chapter 2 provides an overview of the major menus in the Administrator utility. It also explains how to start and exit the utility, how to use the menus, and how to obtain help.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-6
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Once you are familiar with the Administrator utility, follow the instructions in Chapter 3 to create the arrays on the server. After you create the arrays, you must format them as described in Chapter 4.

The remaining chapters address Administrator utility functions that help you manage the arrays. Read these chapters as you need them:

- For information on monitoring arrays, see Chapter 5.
- For information on routine management tasks, such as verifying arrays or reconstructing data, see Chapter 6.
- For information on adding, modifying, or deleting arrays, see Chapter 7.
- For information on using the Administrator utility at a remote workstation, see Chapter 8.

If you receive an error message during any operation, see Appendix A. It lists error messages alphabetically, explains them, and provides possible solutions to the problem.

Those interested in the files included in the Adaptec array software can find a glossary of files in Appendix B. For a quick reference of the menu options in the Administrator utility, see the menu trees in Appendix C.

Conventions

The following typographic conventions are used in this document:

bold
Used for key names (… press the **Enter** key …) and for options you are directed to select (… select **Display Array Status**…).

Helvetica
Used for entries that you must type exactly as shown (… load aruadmin…) and for screen prompts and messages (… New priority:…).

Helvetica italics
Used for program and file names when referenced in the text (… the *startup.ncf* file …).

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 1-7
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

2

Understanding the Administrator Utility

The Administrator utility is the "cockpit" from which you create and manage arrays. The Administrator utility lets you

- Create up to four nonbootable arrays on a server
- Monitor array performance
- Perform array tasks, such as verifying array integrity, testing spare disks, and re-creating data on replacement disks
- Change the arrays on a server—that is, add new arrays, change existing arrays, and delete arrays

This chapter describes the basics of using the Administrator utility. It explains how to start and exit the utility and summarizes the options on the primary menus—the Main and System menus. Subsequent chapters provide detailed instructions for using all options.

Note: Before you start the Administrator utility, make sure the *aha3980.dsk* driver is installed. See *AHA-3980/3985 User's Guide* for instructions.

Starting the Administrator Utility

To start the Administrator utility, follow these steps:

1. If the server is not running, start it.
2. At the server prompt, enter one of the following commands:
   - *First time you start the Administrator utility:* load c:aruadmin
   - *All other times:* load aruadmin

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 2-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Exiting the Administrator Utility

To exit the Administrator utility, follow these steps:

1. Press **Esc** until the following prompt appears:

   Do you want to exit the Administrator? (y|n)

2. Type y. You return to the server prompt.

The Main and System Menus

The Administrator utility has two primary menus: the Main menu, shown in Figure 2-1, and the System menu, shown in Figure 2-2. If your system has only one array, the Main menu appears when you start the Administrator utility. If your system has multiple arrays, the System menu appears when you start the utility.

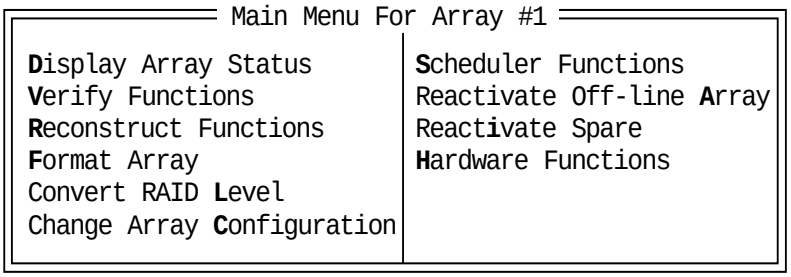

Figure 2-1. The Main menu appears first if you have only one array

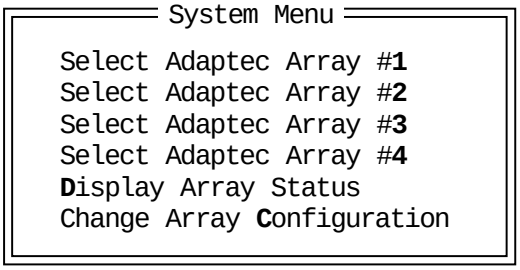

Figure 2-2. The System menu appears first if you have multiple arrays

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 2-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Note: For a quick guide to all menu options, see the menu trees in Appendix C.

Main Menu

The Main menu lists the tasks you can perform for an individual array:

- **Display Array Status:** Display information on the array and on disks included in the array. For details, see *Obtaining Array Information* on page 5-1.
- **Verify Functions:** Verify the data on the array (RAID 5 and mirrored arrays only). For details, see *Verifying Arrays* on page 6-1.
- **Reconstruct Functions:** Re-create data on a replacement disk. For details, see *Reconstructing Data on a Replacement Disk* on page 6-4.
- **Format Array:** Format or initialize an array for a specified RAID level. For details, see Chapter 4, *Formatting Arrays*.
- **Convert RAID Level:** Switch between RAID 0 CVT and RAID 5 CVT formats. For information on why you might do this, see *RAID 0 CVT and RAID 5 CVT* on page 1-3. For instructions, see *Converting between RAID 0 CVT and RAID 5 CVT Formats* on page 7-7.
- **Change Array Configuration:** Add an array (see *Adding an Array* on page 7-1). Change an existing array (see *Modifying an Array* on page 7-4). Delete an array (see *Deleting Arrays* on page 7-9). Change who receives broadcast messages (see *Determining Who Receives Messages* on page 5-5). Change the frequency at which messages repeat (see *Setting the Repeat Interval for Error Messages* on page 5-7). Install the Adaptec array utilities in the NetWare *sys:system* directory (see *Installing the Array Utilities in the sys:system Directory* on page 3-6).
- **Scheduler Functions:** Schedule the Reconstruct, Verify, and Spare Test functions to run automatically at a specified time or regular interval. For details, see *Scheduling Tasks* on page 6-8.
- **Reactivate Off-line Array:** Restore to service an array that is off-line. For details, see *Reactivating an Off-line Array* on page 6-7.

- **Reactivate Spare:** Restore to service a spare disk that has been down. For details, see *Reactivating a Spare Disk* on page 6-7.
- **Hardware Functions:** Perform the following hardware-related tasks: Display the array that uses a specific drive; blink the drive light for a drive (helps you find a specific drive); and suspend activity on the host adapter channels used in an array (for drive boxes that require you to suspend SCSI bus activity before removing a drive). For details, see *Using the Hardware Functions* on page 6-10.

System Menu

If a server has more than one array, the System menu appears when you start the Administrator utility. The first items in the System menu are the array names. If you select an array name, the Main menu for that array appears; this is the same menu described in *Main Menu*, the previous section. Select options in the Main menu to perform tasks related to that array.

The System menu also has the options Display Array Status and Change Array Configuration. Change Array Configuration has the same function as the Change Array Configuration option in the Main menu. Display Array Status is also similar to the Main menu option, but it allows you to view the status of all arrays on the system, not just a selected array.

Selecting Menu Options

Option names in most menus include a *hot key*—a light blue character in color monitors, and a gray character in monochrome monitors. To select one of these options, just type the hot key. In the Main menu in Figure 2-1, for example, the Display Array Status option has the hot key D; to select this option, type d. In this guide, hot keys are indicated by an underlined character in the option name.

You can also select a menu option by pressing the ↑ and ↓ keys to highlight the option and then pressing **Enter**. If an option does not have a hot key, use this method to select it.

Note: If you have a monochrome monitor and the highlight bar is not visible, press **Ctrl-B** to change to monochrome mode.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 2-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Gray Menu Options

Gray menu options are not available to you, usually because they do not apply to the chosen array. If an array has no failed drives, for example, the Reconstruct Functions option on the Main menu is gray, because no drives need to be reconstructed. Similarly, the Convert RAID Level option is always gray for a mirrored array, because you cannot convert a mirrored array to another format.

You cannot select a gray menu option. If you try to select it, the utility displays a message explaining why you cannot.

Getting Help

You can display Help windows for most menus by pressing the **F1** key. As you highlight menu options, the Help windows automatically change to provide information about the highlighted option. To clear the Help windows, press the **F1** key again.

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3

Setting Up the Initial Arrays

Setting up the initial arrays on a server involves

- Creating the arrays
- Installing the array utilities in the NetWare *sys:system* directory

This chapter explains the steps for setting up the initial arrays. It also describes how the Administrator utility automatically modifies the NetWare *startup.ncf* and *autoexec.ncf* files so the server recognizes the arrays whenever it starts.

Note: If you have not yet installed the NetWare drivers for the AHA-3980/3985, do so before you set up the arrays (see *AHA-3980/3985 User's Guide* for instructions). When you install the drivers, you also install the RAID utilities—in the DOS directory containing the *server.exe* file. The RAID utilities *must* be in this directory for you to create the initial arrays.

Creating the Initial Arrays

The first time you run the Administrator utility on a server, the utility automatically leads you through each step needed to create up to four arrays. Using menus and prompts, it has you define the following array characteristics:

- The RAID level
- The drives in the array
- (Mirrored and RAID 5 arrays only) Spare drives, if you choose to use spares

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 3-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Note: Once you set up the initial array(s), the Administrator utility no longer prompts you to create an array when you start the utility. To add new arrays after this point, use the Change Array Configuration option described in *Adding an Array* on page 7-1.

Before you run the Administrator utility the first time, determine the drives and RAID level you want for each array. *Adaptec Arrays* on page 1-1 describes the different RAID levels and the disk requirements for each RAID level. Once you decide the array characteristics, follow these steps to define the arrays:

1. At the DOS prompt, start the server by entering

   ```
   server
   ```

2. At the server prompt, enter

   ```
   load c:aruadmin
   ```

   A message informs you that no array driver is loaded (no arrays are found), and asks if you want to set up arrays.

3. Type y to set up the arrays. (If you type n, you return to the server prompt without setting up any arrays.)

   Note: The Administrator utility scans the *startup.ncf* file for array load lines (see *The startup.ncf and autoexec.ncf Files* on page 3-7). If it detects a load line, it informs you and warns you that continuing will delete the load line. Type y to delete the load line and set up new arrays; or type n to stop and return to the server prompt.

   The Selection List menu appears, as shown in Figure 3-1. This menu lists the four possible arrays: Adaptec Array #1 through #4.

4. Press **Enter** to select the first array (you must select array numbers in sequence). The Select Array Type menu appears in the upper left corner of the screen.

5. Select the array type: **RAID0**, **RAID0 CVT**, **Mirrored**, **RAID5**, or **RAID5 CVT**.

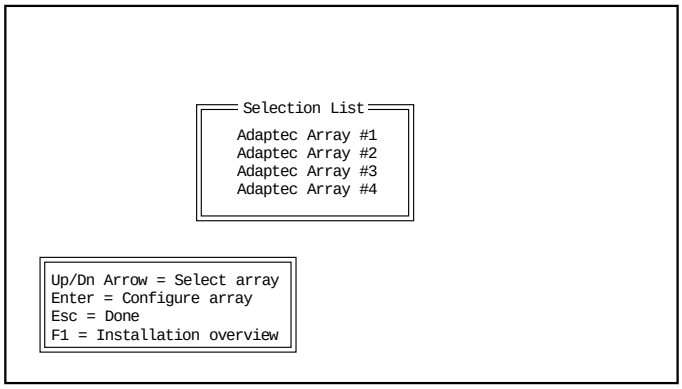

Figure 3-1. Selection List menu

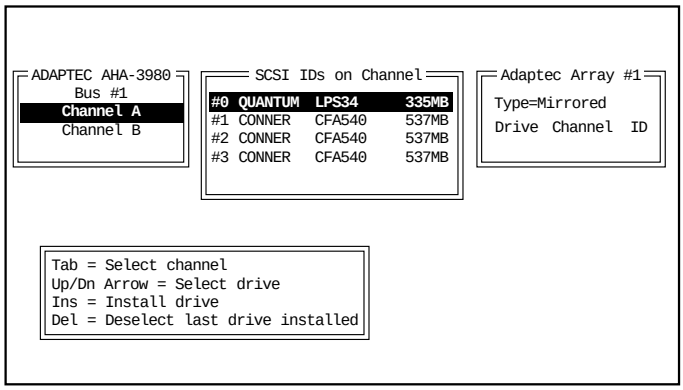

Figure 3-2. Drive selection screen

6 If the system has more than one AHA-3980 or AHA-3985, the RAID Boards menu appears, listing the AHA-3980 and AHA-3985 boards. Select the host adapter with the drives you want to use for this array.

A prompt appears, asking how many drives the array will contain, *excluding* spares.

7 Type the number of drives (excluding spares) you want in the array, and press **Enter**.

The utility scans the selected host adapter for drives, then displays a drive selection screen such as that in Figure 3-2. This screen has the following components:

- *The AHA-3980 or AHA-3985 menu*—This lists the host adapter channels. An AHA-3980 has two channels (A and B), and an AHA-3985 has three channels (A, B, and C).
- *The SCSI IDs on Channel menu*—This lists the manufacturer, model number, and capacity of drives on the highlighted host adapter channel.
- *The Adaptec Array # box*—This box is initially empty when the screen appears. As you select drives for the array, as described next, the names of the selected drives appear in the Adaptec Array # box.

8 Follow these steps to select the drives for an array:

a Press **Tab** to highlight a host adapter channel you want to use for the array. The disks on the highlighted channel appear in the SCSI IDs on Channel menu.

b Select each drive for the array by pressing the ↑ and ↓ keys until the disk name is highlighted, and then pressing the **Insert** or **Enter** key. Selected disk names are grayed.

Caution: If you choose disks that contain data, all the data will be lost when you format the array. Do *not* choose your boot disk, therefore, as part of an array. Also, do *not* choose disks that contain NetWare volumes you want to keep, such as the *sys* volume.

To cancel the last selection, press the **Delete** key. To cancel an earlier selection, press the **Delete** key until the disk name no longer appears in the Adaptec Array # box (this cancels all disk selections back to that point, so you must reselect those disks you still want in the array).

c To select disks on a different channel, repeat steps a and b.

When you have selected the number of disks you specified in step 7, the next screen appears automatically. The screen that appears depends on the array type and the number of non-array disks remaining on the host adapter.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 3-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

9 If the array is mirrored or RAID 5 *and* you have a disk left, a prompt appears, asking whether you want to choose a spare disk:

If you do not want a spare: Type n and continue with step 10.

To select a spare: Follow these steps:

a At the prompt, type y.

b If you have more than one disk available, a second prompt appears, asking how many spares the array will have. Type the number (1 or 2), and press **Enter**.

c Follow the directions in step 8 to select each spare. When you have selected the specified number of spares, the Selection List menu reappears automatically.

Note: A spare must have at least the capacity of the smallest disk in the array.

10 To create another array, select the next array from the Selection List menu, then repeat steps 5 through 9.

11 When you have finished creating arrays and you are back at the Selection List menu, press **Esc**. A pop-up menu appears.

12 Select one of the following options:

Accept Configuration: To confirm the array configurations you specified. Use this option when you are finished defining arrays.

Return to Setup: To return to the Selection List menu. Use this option if you want to redefine one of the arrays. When you return to the Selection List menu, select the array you want to redefine, then repeat steps 5 through 12.

Cancel Setup: To cancel the new array configurations and return to the server prompt. In this case, no arrays are set up.

When you select Accept Configuration, the Administrator utility inserts a load line for each array in the NetWare *startup.ncf* file (see *The startup.ncf and autoexec.ncf Files* on page 3-7). If the NetWare *sys:system* directory exists, the Administrator utility also copies the

array utilities to that directory. If the *sys:system* directory does not exist, you must create it later and copy the utilities to it (see *Installing the Array Utilities in the sys:system Directory* below).

When the Administrator utility finishes, it prompts you to press any key to continue. Continue with these steps:

1. Press any key. The System menu appears if you defined more than one array; otherwise, the Main menu appears.
2. Format the arrays as described in Chapter 4.

Note: You cannot use newly created arrays until you format them. If you are moving an existing, formatted array to a new server, however, you need not reformat the array—as long as you defined it to have the same RAID level and disks used in the original format, and the disks are in the same order.

3. Restart the server.

The server now recognizes only the virtual disks defined by the arrays; the individual disks in the arrays are invisible to the server. Set up volumes on the virtual disks as you would on any disk (see the NetWare documentation for instructions).

Installing the Array Utilities in the sys:system Directory

The array utilities must be installed in the NetWare *sys:system* directory. If *sys:system* exists when you create the initial arrays, the Administrator utility automatically installs the array utilities in *sys:system*. Otherwise, you must install the utilities later, after you create the *sys:system* directory. This may happen, for example, if you plan to place the *sys:system* directory on an array and so cannot create the directory until you define and format the arrays.

To install the array utilities in *sys:system*, follow these steps:

1. Create the *sys* volume, following the instructions in the NetWare documentation. The procedure for creating the volume on an array is the same as that for creating it on any disk.
2. Start the Administrator utility by entering

   ```
   load c:aruadmin
   ```

3 From the System menu or the Main menu, select **Change Array Configuration**.

4 Select **Install Utility Suite**.

The Administrator utility copies the array utilities to the *sys:system* directory.

The startup.ncf and autoexec.ncf Files

When you define an array, the Administrator utility automatically modifies the *startup.ncf* file to load the array when the server starts. The load line has the form illustrated in the following example:

```
load ardrvr {1(A1)(A2)(B0)(B2)[B3]}
```

where {} denotes an array definition, () denotes a disk definition, and [] denotes a spare definition. The single number at the beginning of the array definition (1 in this case) is the PCI bus number, which identifies the host adapter. The letter in the disk or spare definition is the host adapter channel to which the disk is attached; the number in the disk or spare definition is the SCSI ID of that disk. In the example, (A1) denotes a disk that is on Channel A and has SCSI ID 1.

The Administrator utility also modifies the *autoexec.ncf* file, inserting a load line for the Array Monitor utility, *arumon*. This causes the Array Monitor utility to load whenever the server starts.

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Formatting Arrays

Whenever you create an array or redefine disks (other than spares) in an existing array, you must format the array. To do so, you can

- Perform a low-level format, or
- Initialize the array with zeroes

Both types of formatting accomplish the same things: they erase all existing data on an array, and format the array for the specified array type. Once you low-level format or initialize an array, the array is ready for use.

Choosing the Formatting Method

You have two options for formatting an array: Low-level Format or Initialize Array to Zero. Either method is acceptable. In choosing a method, consider the advantages and disadvantages of each:

- **Low-level Format**: Performs a low-level SCSI format. This writes a consistent pattern to the disks and checks the disks for defects. Low-level formatting can be slow (hours), with the speed varying by drive model. You cannot abort low-level formatting. You also cannot exit to DOS while formatting is under way—you will hang the system.
- **Initialize Array to Zero:** Fills the array with zeroes. This option is usually faster than the Low-level Format option, but does not verify the integrity of the disks. You can abort an initialization or exit to DOS while it is under way; in both cases, however, you must later complete the initialization.

Check with your vendor or your drive documentation to learn how your drives handle low-level formatting. If you find the low-level formatting speed is acceptable to you, low-level formatting is the better choice.

Choosing the Data Block Size

When formatting arrays other than RAID 1 arrays, you must choose the size of the data blocks that will be striped across the array. The allowable sizes are 8, 16, 32, or 64 KBytes; the default size is 16 KBytes. For best performance, the data block size should be the same size you intend to use for the volume block size, or one size larger. (For information on volume block sizes, see the NetWare documentation.)

Note: You do not choose a data block size for RAID 1 arrays (mirrored arrays with only two disks), because they do not involve striping across disks.

Formatting the Array

Once you decide on the formatting method and the block size, follow these steps to initialize or low-level format an array:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array you want to format. The Main menu for that array appears.
2. From the Main menu, select **Format Array**. The Format menu appears.
3. Select the RAID format: **RAID0**, **RAID5**, **Mirrored**, **RAID0 CVT**, or **RAID5 CVT**. (For a description of these RAID levels, see *Array Types* on page 1-1.) The Select Format Mode menu appears.

Note: If you selected a different RAID level when you defined the array, the format you select here supersedes that selection. This causes no problems with the array, as long as the number of drives you defined is suitable for the RAID format you select here. If the number is unsuitable, an onscreen message tells you.

4 Select **Initialize Array to Zero** or **Low-Level Format**.

> **Caution:** Remember, formatting or initializing an array erases all data on the array disks. If the array disks contain data you want to keep, be sure to back them up before you format the array!

A menu of block sizes appears (this menu does not appear if the array is a mirrored array with only two drives).

5 Select a block size. For recommended block sizes, see *Choosing the Data Block Size* on page 4-2.

6 When prompted to confirm you want to format the array, type y (yes). When prompted to confirm this again, type y again. (You are given two opportunities to stop formatting, to make doubly sure you do not accidentally format the array—and so accidentally erase existing data.)

The Administrator utility begins formatting the array. The Configuration screen for the array appears, as shown in Figure 4-1. In that screen, the Utility Running field indicates that formatting (either initializing or low-level formatting) is under way. If you are initializing the array, a message on the second line indicates the percentage of initialization that is complete.

> **Note:** If you exit the Configuration screen, you can redisplay it by selecting **Display Array Status** from the System or Main menu, and then selecting **Display Array Drive Status**.

The Format utility also tracks formatting. For initialization, it displays a status bar indicating the percentage of initialization

```
Configuration for Array #1

Array Type = Mirrored       Drives = 2    Utility Running = Initializing
Utility is 90% complete                   Priority = 0

Member  SCSI ID  Channel     Status      Capacity     Side      Mirror
 0         1        A     Initializing     515MB    Primary     #1
 1         3        A     Initializing     515MB    Secondary   #0
 Spare0    6        B          UP          515MB
```

Figure 4-1. The Configuration screen shows the percentage of formatting completed

completed. For low-level formatting, it displays the elapsed formatting time. To display this information, press **Alt-Esc** until the Adaptec RAID Format Utility screen appears. You can display this screen even if you exit the Administrator utility.

Note: After you format an array, view the status screens for that array to verify the array configuration. See *Obtaining Array Information* on page 5-1 for instructions.

Canceling Formatting

You can cancel formatting after it is under way only if you selected Initialize to Zero as the formatting method. To cancel the initialization, press **Alt-Esc** until the status bar appears, press **Esc** to display a pop-up menu, and then select **Abort**.

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 4-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

5

Monitoring Array Performance

The Administrator utility monitors the performance of the arrays and compiles statistics—for example, number of reads and writes and number of bad sectors reassigned. With the Administrator utility, you can view these performance statistics at the server console. If you have the Adaptec CI/O software, you can also view the statistics at a remote workstation.

The Administrator utility also monitors arrays for problems, such as failed drives. If it detects a problem, it issues an alert. Use the Administrator utility to determine who receives the alerts and how often the alerts repeat onscreen. If you have the Adaptec CI/O software installed at a remote workstation, the alerts appear there also.

Obtaining Array Information

You can display the following types of information for any array on a server:

- An overview of the logical array characteristics (see Figure 5-1)
- An overview of physical array characteristics and any utilities running on the array (see Figure 5-2)
- Performance statistics for an array and its drives

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 5-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

```
Overview for Array #1

Array Model = AHA-3980 Two Channel RAID
Creation date = Tue Oct 4 11:11:57 1994
Array Type = Mirrored
Array Physical Capacity = 515MB
State = Fault-tolerant
Drives = 2
Spare Drive Count = 1
Date of last Verify is Fri Jan 27 18:14.
Date of last reconstruction is NEVER.
Error message repeat interval is 15 minutes.
```

Figure 5-1. The Overview screen, which shows logical array characteristics

```
Configuration for Array #1

Array Type = Mirrored     Drives = 2    Utility Running = Verify
Utility is 90% complete                 Priority = 0

Member  SCSI ID  Channel  Status  Capacity    Side      Mirror
 0         1        A       UP       515MB   Primary     #1
 1         3        A       UP       515MB   Secondary   #0
 Spare0    6        B       UP       515MB
```

Figure 5-2. The Configuration screen, which shows physical array characteristics and indicates any utilities running on the array

Displaying Overview Information

To display the overview information for the array and the drives, follow these steps:

1. Start the Administrator utility. If the system has more than one array, the System menu appears; otherwise, the Main menu appears.
2. From either menu, select **Display Array Status**. The Status menu appears.
3. Select one of the following options:

   Display Array Overview: To view array information such as that shown in Figure 5-1.

   Display Array Drive Status: To view drive information such as that shown in Figure 5-2.
4. If in step 2 you selected from the System menu, you can view information on the next array by pressing any key. Repeat this step to scroll through information screens for each array.

5 At the last information screen, press any key to return to the Status menu.

6 Press **Esc** to return to the System menu or Main menu.

Displaying Performance Statistics

To display the performance statistics for an array or the disks in an array, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System menu select the array for which you want the statistics. The Main menu for that array appears.

2 From the Main menu, select **Display Array Status**. The Status menu appears.

3 Select **Display Statistics**. The Statistics menu for that array appears.

4 Select one of the following options:

Temporary Array Statistics: To display for the entire array the number of read requests and write requests.

Temporary Drive Statistics: To display for each drive the number of reads, the number of writes, and the total sectors read from and written to.

Permanent Drive Statistics: To display for each drive the errors that were corrected, successful retries, and reassigned blocks.

5 When finished viewing the screen of statistics, press **Esc** to display a pop-up menu and then select **Quit**.

Note: Totals are reset to zero when an array is formatted or when you reset the totals to zero (see *Resetting the Temporary Statistics to Zero* on page 5-4).

Changing the Data Sampling Rate

To develop the performance statistics, the arrays and drives are sampled once every second. If this slows the driver performance when

you use other programs, you can increase the sampling rate through either of the following methods:

- Display the Statistics menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 5-3), and select **Set Sampling Rate**. At the prompt that appears, type the new sampling interval (in seconds) and press **Enter**.
- At any screen displaying the statistics, press **Esc**. From the pop-up menu that appears, select **Change Sampling Rate**. At the prompt, type the new sampling interval (in seconds) and press **Enter**.

Resetting the Temporary Statistics to Zero

The totals for the statistics are reset to zero when you format an array. You can rezero the temporary statistics at any other time through either of the following procedures:

- Display the Statistics menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 5-3), and select **Reset Temporary Statistics**.
- At any screen displaying statistics, press **Esc**. From the pop-up menu that appears, select **Reset Statistics**. When prompted to confirm you want to reset the statistics, type **y**. Like the first method, this method rezeros all temporary statistics (not just those displayed onscreen).

Saving the Statistics in the Log File

You can save the current statistics in the *aru.log* file (for information on this file, see *The Log File* on page 5-7). To do so, use either of the following procedures:

- Display the Statistics menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 5-3), and select **Log Current Data Values**.
- At any screen displaying statistics, press **Esc**. From the pop-up menu that appears, select **Log Current Data Values**. Like this first method, this saves all current values (not just those displayed onscreen).

Each time you save the statistics, they are appended to the *aru.log* file. They do not overwrite previously saved statistics.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 5-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Determining Who Receives Messages

The Administrator utility broadcasts messages when it detects a problem (for example, a failed drive) or when you change the message repeat interval. Table 1 lists the broadcast messages.

Table 1. Broadcast Messages

Broadcast Message	Meaning
Array #*n* went off-line.	The array is not responding. Verify that all drives in the array have power and that all cables are properly connected. If the array still does not respond, drive(s) in the array may have failed.
Spare drive #*m* of *n* failed Ready test.	The spare did not respond to the signal sent during the Spare Testing operation (see *Testing Spare Disks* on page 6-4). Verify that the drive has power and that all cables are properly connected. If the drive still does not respond, it may have failed.
Message repeat interval changed from *n* to *m* minute(s).	A user has changed the interval at which error messages repeat onscreen (see *Setting the Repeat Interval for Error Messages* on page 5-7).
Drive #*n* of Adaptec disk array #*n* went DOWN.	The drive is not responding. Verify that the drive has power and that all cables are properly connected. If the drive still does not respond, it may have failed.
Adaptec disk array monitor has lost contact with the array driver.	The array monitor cannot find the array driver. This message appears if you unloaded the array driver, but not the array monitor. If you receive this message when the array driver is loaded, the array driver is not responding to the monitor. Restart the server and try again. If the driver still does not respond, call Adaptec Technical Support at the number listed on page -ii.
Spare for array #*n* not activated - STARTUP.NCF not accessible.	The utility tried to modify the array load line in the *startup.ncf* file to reflect the changed status of the spare, but could not find the *startup.ncf* file. This means DOS is not resident in memory. Restart the server and do *not* remove DOS; then restart the Administrator utility and try the procedure again.

Messages can be broadcast to everybody on the server connection list, to selected persons on the connection list, or to nobody. To choose who will receive messages, follow these steps:

1. From the System menu or the Main menu, select **Change Array Configuration**.
2. Select **Change Broadcast Mode**. The Broadcast Modes menu appears. At the bottom of the screen, a status message indicates the current broadcast mode.
3. Select one of these options:

   Do not broadcast any messages: To have messages appear only at the server console.

   Broadcast all messages to everyone on connection list: To have messages appear at the workstations of everyone on the server connection list.

   Broadcast only to specified locations: To choose the workstations where the messages appear.
4. If you choose **Broadcast only to specified locations**, the Administrator utility creates a file named *arubcast.lst* in the *sys:system* directory. A message noting this appears onscreen. Press any key to clear the message, then edit the *arubcast.lst* file to enter the workstations where messages will appear. Each line in the file can have one name, which must be typed exactly as it appears in the server connection list. To specify connections named Ron, Gary, Pratibha, Jim, Viren, and Forrest, for example, the file appears as

   Ron
   Gary
   Pratibha
   Jim
   Viren
   Forrest

   The number of lines in the *arubcast.lst* file is unlimited.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 5-6
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Note: The locations you select (everyone, no one, or specified locations) apply to all arrays, even if you selected a specific array from the System menu.

Setting the Repeat Interval for Error Messages

Error messages repeat onscreen every 15 minutes by default. Several beeps call your attention to the message. To change the interval at which the messages repeat, follow these steps:

1. From the System menu or the Main menu, select **Change Array Configuration**.
2. Select **Change Message Repeat Cycle**. A prompt appears, indicating the current repeat interval and prompting you to enter the new one.
3. Type the new repeat interval (in minutes) and press **Enter**. To specify no repeats, enter 0.

This changes the interval for all error messages on all arrays, even if you selected a specific array from the System menu. You cannot select different intervals for different error messages or for different arrays.

The Log File

The *aru.log* file provides an audit trail of events and error messages. It is stored in the *sys:system* directory. If you receive an error message or have a problem with the arrays, check the log file to determine the sequence of events that led to the problem. This will help you troubleshoot the problem. Periodically you should back up the log file and then delete it.

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Managing Arrays

Use the Administrator utility to routinely verify arrays and test spare disks, and to perform such nonroutine tasks as reconstructing data on replacement disks and reactivating off-line arrays and spare disks. The utility's Scheduler function lets you schedule most of these tasks to run automatically at a specified time or interval.

Verifying Arrays

Use the Administrator utility to verify the consistency of data on mirrored and RAID 5 arrays. If a mirrored or RAID 5 array becomes inconsistent, you lose data if a drive in the array fails. We recommend that you verify arrays after you set them up and at least weekly thereafter.

Verification works as follows:

- **Mirrored arrays:** Data on the primary drive in a pair is compared block by block with the data on the secondary drive. If data blocks do not match, the data block on the primary drive is copied to the secondary drive.
- **RAID 5 arrays:** The parity data is compared with the data blocks it represents. If an inconsistency is detected, the parity is updated to be consistent with the data blocks.

Note: You cannot verify an array that contains a disk that is down.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Verification runs in the background, so you can continue your work while verification is under way.

Assigning a Priority

You assign verifications a priority on the server. The priority, which can be 0 through 9, determines the proportion of verification I/O operations relative to other system I/O operations. At priority 1, 1 of 10 system I/O operations will be verification I/O operations; at priority 2, 2 of 10; at priority 3, 3 of 10; and so on. At priority 0, the lowest priority, verification I/O operations occur only when the system is free.

Verifying an Array Immediately

To verify an array immediately, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array you want to verify. The Main menu for that array appears.
2. From the Main menu, select **Verify Functions**. The Verify menu for that array appears.
3. Select **Start Verify**. At the bottom of the screen, the prompt Enter background priority (0-9) appears.
4. Indicate the priority by typing a number from 0 through 9 (0 assigns it the lowest priority; 9, the highest).

Verification begins, and the Configuration screen for the array appears (see Figure 6-1). In that screen, the Utility Running field indicates that the verification is under way. A message on the second line indicates the percentage of verification that is complete.

Note: If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main menu, and then selecting **Display Array Drive Status**.

The Verify utility also tracks verifications, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt-Esc** until the status bar appears. You can display the status bar even if you exit the Administrator utility.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

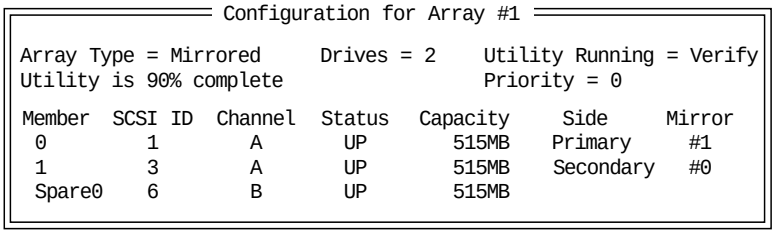
Configuration for Array #1
Array Type = Mirrored
Drives = 2
Utility Running = Verify
Utility is 90% complete
Priority = 0
Member SCSI ID Channel Status Capacity Side Mirror
0 1 A UP 515MB Primary #1
1 3 A UP 515MB Secondary #0
Spare0 6 B UP 515MB

Figure 6-1. The Configuration screen shows the percentage of verification completed

While Verify runs, the logical block addresses (LBAs) of any repaired data blocks appear onscreen. If no bad blocks were repaired, no message appears. Information on repaired blocks is also recorded in the *aru.log* file (see *The Log File* on page 5-7).

Note: By default, the Administrator utility corrects parity data automatically. To disable automatic correction, change the Auto-Correct flag in the *aru.ini* file from y to n. See *aru.ini* on page B-3 for details.

Verifying an Array at a Scheduled Time

Use the Scheduler to automate verifications and ensure they are done at regular intervals. For details, see *Scheduling Tasks* on page 6-8.

Canceling a Verification

You can cancel a verification while it is under way, using either of the following procedures:

- From the Verify menu, select **Abort Verify**.
- At the status bar screen, press **Esc**. From the menu that appears, select **Abort**.

An onscreen message confirms that the verification was aborted.

To cancel a scheduled verification, delete it from the schedule. For instructions, see *Deleting a Scheduled Task* on page 6-9.

Changing the Priority of a Verification in Progress

If a verification is slowing other server operations unacceptably, you can lower the priority of the verification on the server. Conversely, you can speed a verification by increasing its priority.

Change the priority at either the Verify menu or at the screen showing the Verify status bar:

- From the Verify menu, select **Change Priority**. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.
- From the Verify status bar screen, press **Esc**. From the menu that appears, select **Change Priority**. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

Verification continues automatically, running at the new priority.

Testing Spare Disks

Routinely test any spare disks in an array—we recommend daily testing. In this quick test, the Administrator utility sends a signal to the spare and checks whether the disk responds. The test involves no physical testing of the disk surface.

To test spare disks, use the Scheduler. Instructions are in *Scheduling Tasks* on page 6-8.

Note: If a test fails, the message Spare drive #*n* of *m* failed Ready test appears onscreen. Verify that the drive has power and that the cables are properly connected; then retry the test. If the test still fails, the drive may have failed.

Reconstructing Data on a Replacement Disk

If you replace a failed disk in a mirrored or RAID 5 array, use the Administrator utility to reconstruct the data on the replacement disk (you cannot reconstruct data in a RAID 0 array). RAID 5 data is reconstructed from the user and parity data on the good disks. RAID 1

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

data is copied from the other disk in the mirrored pair. Data is reconstructed in the background, allowing you to continue working.

Note: If your drive box requires that all host adapter activity stop while you replace a drive, use Hot Swap Pause. For details, see *Pausing Host Adapter Activity When Replacing Disks* on page 6-12.

Reconstructing the Data Immediately

You can reconstruct data immediately or schedule it to be reconstructed at a specified time. To reconstruct the data immediately, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array containing the replacement disk. The Main menu for that array appears.
2. From the Main menu, select **Reconstruct Functions**. The Reconstruct menu for that array appears. Menu options that do not apply to that array type are gray, indicating you cannot select them. If the array is mirrored, for example, you can select only Re-mirror Single Drive or Re-mirror all DOWN Drives.
3. Select the option you want. A new screen appears, displaying the current drive statistics for that array. At the bottom of the screen, a prompt asks you to assign a priority to the operation.
4. Indicate the priority by typing a number from 0 through 9, where 0 indicates the lowest priority. Another prompt appears, asking you to confirm you want to continue.
5. Type y to continue, or n to cancel the operation.

As Reconstruction begins, the Configuration screen for the array appears (this is similar to the screen in Figure 6-1). A message on the second line indicates the percentage of reconstruction completed.

Note: If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main menu, and then selecting **Display Array Drive Status**.

The Reconstruct utility also tracks reconstructions, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt-Esc** until the status bar appears.

Reconstructing the Data at a Scheduled Time

Because reconstructing data may slow a system, you may want to schedule this operation for a time when system use is light. You can use the Scheduler to start reconstructing the data automatically at a specified time. For details, see *Scheduling Tasks* on page 6-8.

Canceling Reconstruction

You can cancel reconstruction while it is under way, using either of the following procedures:

- From the Reconstruct menu, select **Abort Reconstruct**.
- At the Reconstruct status bar screen, press **Esc**. From the menu that appears, select **Abort**.

An onscreen message confirms that the operation was aborted.

To cancel a scheduled operation, delete it from the schedule. For instructions, see *Deleting a Scheduled Task* on page 6-9.

Changing the Priority for Reconstructing Data

As with verifying data, you can change the priority assigned to reconstructing data while the operation is under way. Use one of the following methods:

- From the Reconstruct menu, select **Change Priority**. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.
- From the status bar screen, press **Esc**. From the menu that appears, select **Change Priority**. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

The operation continues automatically, running at the new priority.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-6
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Reactivating an Off-line Array

An array goes off-line if the power fails or if someone removes a second disk when one has already been removed. To reactivate an off-line array, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array you want to reactivate. The Main menu for that array appears.
2. From the Main menu, select **Reactivate Off-line Array**. A prompt appears, asking you to confirm that you want to reactivate the array.
3. Type y to reactivate the array, or n to cancel the operation.

Reactivating a Spare Disk

If a disk fails in an array that has spares, a spare is automatically activated and the failed disk is marked *Down*. When you replace the failed disk, the replacement disk becomes the new spare. To reactivate the new spare, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array containing the spare you want to reactivate. The Main menu for that array appears.
2. From the Main menu, select **Reactivate Spare Disk**. A menu lists the spares that are currently inactive.
3. Select the spare you want to reactivate. A prompt appears, asking you to confirm that you want to reactivate the spare.
4. Type y to reactivate the spare, or n to cancel the operation.

Scheduling Tasks

The Scheduler lets you schedule the following tasks:

- Verifying mirrored and RAID 5 arrays
- Testing spare disks
- Reconstructing data on a replacement disk

If you use the Scheduler to schedule verifications, all arrays are verified. To verify only one array, follow the procedure given in *Verifying Arrays* on page 6-1.

Scheduling a Task

Follow these steps to schedule a task:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array for which you want to schedule a task. The Main menu for that array appears.
2. From the Main menu, select **Scheduler Functions**. The Scheduler menu appears.
3. Select **Schedule Verify**, **Schedule Reconstruct**, or **Schedule Spare Testing**. A second Scheduler menu appears.
4. Select one of these options:

   Schedule Task to Run Once: To schedule the task for a single time.

   Schedule Cyclic Task: To schedule the task to run at regular intervals.

   Test Now (appears only if you selected Schedule Spare Testing): To test the spare immediately. If you select this option, you are finished—ignore the remaining steps.
5. If you select Schedule Cyclic Task, the Task Schedule Intervals menu appears. Select one of these options: **Schedule Daily**, **Schedule Weekly**, or **Other**.
6. Depending on the options you selected, you are prompted for one or more of the following: day of week, time of day, and hourly interval when you want the task to run:

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-8
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

- *To enter a day of the week:* Type the first three letters of its name and press **Enter**. To enter Monday, for example, type mon and press **Enter**. You can use upper or lower case letters.
- *To enter a time of day:* Type the hour and minutes (for example, 01:30) and press **Enter**. Use a 24-hour clock, and use leading zeroes before single-digit numbers. For 2:05 a.m., for example, enter 02:05; for 2:05 p.m., enter 14:05.
- *To enter an interval:* Type the interval in hours—using a leading zero before single-digit numbers—and press **Enter**. To specify an interval of 8 hours, for example, enter 08.

7 If you are scheduling a verification, a new menu appears. Select **In Parallel** to have all arrays verified at the same time, or **Serially** to have the arrays verified in sequence.

Note: Verifying arrays in parallel usually slows your system more than verifying them in series.

Changing the Schedule

To change the schedule for a task, follow the procedure given in *Scheduling a Task* (beginning on page 6-8), entering the information for the new schedule. The new schedule automatically replaces the old schedule for that task.

Deleting a Scheduled Task

You can delete a scheduled task by following these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System menu select the array for which you want to schedule a task. The Main menu for that array appears.

2 From the Main menu, select **Scheduler Functions**. The Scheduler menu appears.

3 Select **Unschedule Verify, Unschedule Reconstruct**, or **UnSchedule Spare Testing**.

Using the Hardware Functions

The Hardware Functions option provides tools for

- Identifying the array that uses a specific drive
- Identifying the location of a selected drive by blinking the light on the front panel of the drive
- Suspending host adapter activity while you replace drives in an array

Identifying the Allocation of Host Adapter Drives

You can quickly identify where each host adapter drive is used by selecting the Display Host Adapter Drives option. This option lets you display for every drive the following information:

- The array that contains the drive
- The ordinal number of the drive in the array

To display the information, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select *any* array. The Main menu appears.
2. From the Main menu, select **Hardware Functions**.
3. Select **Display Host Adapter Drives.** A screen similar to that in Figure 6-2 appears**.**
4. In the menu at the left of the screen, press the **Tab** key to highlight the host adapter channel whose drives you want to display. The drives for that channel appear to the right, in the SCSI IDs on Channel menu.
5. Press the ↑ and ↓ keys to highlight the drive names. As you highlight each drive name, the array information for that drive appears in the box at the right of the screen.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-10
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

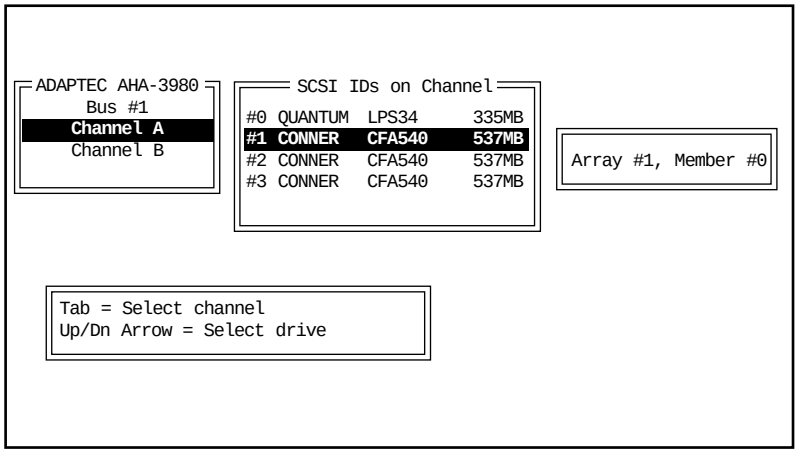

Figure 6-2. When you select a drive, the box at the far right shows the array that contains the drive and the ordinal number of the drive in the array

Locating a Drive

If you are not sure which drive corresponds to drive information displayed onscreen, you can use the Blink Drive Lights option to locate the drive. From the onscreen information, note the number of the array that contains the drive, then follow these steps to blink the drive light:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array that uses the drive. The Main menu for that array appears.
2. From the Main menu, select **Hardware Functions**.
3. Select **Blink Drive Lights**. The Configuration screen for the selected array appears (see Figure 6-1 on page 6-3).
4. Use the ↑ and ↓ keys to select the drive you want to identify. The selected drive is denoted by an arrow to the left of the drive number (the first column on the screen).
5. To blink the drive light for the selected drive, press **Enter**. A blinking icon appears to the right of the drive number, and the drive light itself starts blinking.
6. To stop blinking the drive light, press **Enter** again.

Pausing Host Adapter Activity When Replacing Disks

Some drive enclosures allow you to remove and replace drives while SCSI bus activity continues; others do not. If your drive enclosure does not (check the documentation for the enclosure), use the Hot Swap Pause option before you remove or replace any drives in an array. Hot Swap Pause suspends activity on all SCSI buses (host adapter channels) used in the array.

To use Hot Swap Pause, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array containing the disk you are removing. The Main menu for that array appears.
2. From the Main menu, select **Hot Swap Pause**. A prompt appears, asking you to confirm you want to continue.

Note: If you continue, activity to non-array drives will be paused, as well as activity to array drives.

3. To continue, type y. Otherwise, type n.

While SCSI bus activity is paused, the server beeps to remind you to replace the drive and resume activity. When you have replaced the drive, resume SCSI bus activity by pressing any key at the Administrator utility screen.

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 6-12
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

7

Changing Array Configurations

After you create the initial arrays on a server, you can later add new arrays and modify or delete existing arrays. This chapter explains how to

- Add one or more arrays to the server
- Modify an array by changing the RAID level, the drives in the array, or the number of spares
- Convert a RAID 0 CVT array to a RAID 5 CVT array and vice versa
- Delete one or all arrays on the server

Adding an Array

Adding new arrays is similar to setting up the initial arrays: You select the array you want to add, choose the RAID level, and then select the drives and any spares for the array. The steps are as follows:

1. From the System menu or the Main menu, select **Change Array Configuration**.
2. Select **Add an Array**. The Selection List menu appears, listing all possible arrays—defined or undefined. If you highlight an existing array, information on its configuration appears to the right of the Selection List menu, as illustrated in Figure 7-1.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

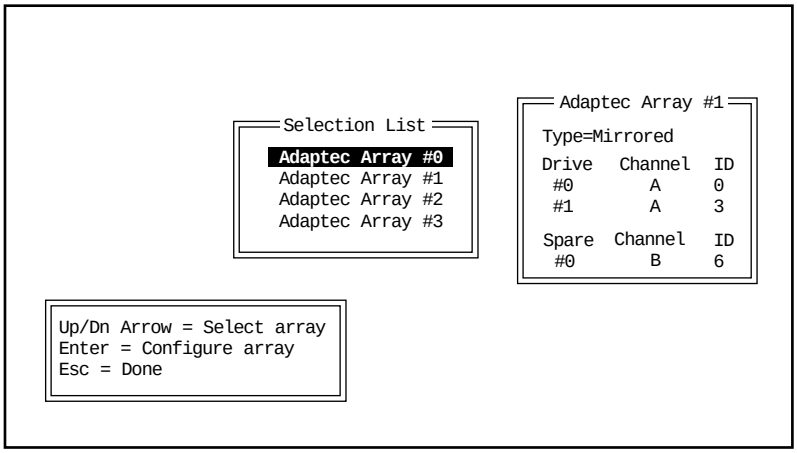

Figure 7-1. Selection List menu. If you highlight an existing array, information on that array appears to the right of the menu.

Note: Do not use the Add an Array option to modify existing arrays. Instead, see *Modifying an Array* on page 7-4 for instructions.

3 From the Selection List menu, select the array you want to add. The Select Array Type menu appears in the upper left corner of the screen.

4 Select the array type: **RAID0**, **RAID0 CVT**, **MIRRORED**, **RAID5**, or **RAID5 CVT**. The RAID Boards menu appears.

5 Select the host adapter you want to use. A prompt appears, asking how many drives the array will contain, *excluding* spares.

6 Type the number of drives (excluding spares) you want in the array, and press **Enter**. The utility scans the host adapter for drives, then displays a screen such as that shown in Figure 7-2.

7 Press **Tab** to highlight a channel you want to use for the array. When the disks on the highlighted channel appear in the SCSI IDs on Channel menu, select each disk for the array by pressing the ↑ and ↓ keys until the disk name is highlighted, and

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

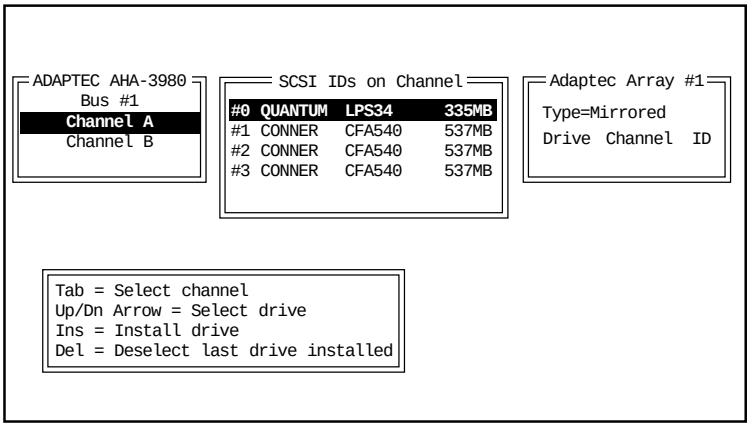

Figure 7-2. Selecting drives for an array

then pressing the **Insert** or **Enter** key. The names of selected disks appear to the right, in the Adaptec Array # box.

Caution: If you choose disks that contain data, all the data will be lost when you format the array. Do *not* choose your boot disk, therefore, as part of an array. Also, do *not* choose disks that contain NetWare volumes you want to keep, such as the *sys* volume.

To select disks on a different host adapter channel, press **Tab** to select another channel and then select the disks from the SCSI IDs on Channel menu. To deselect a disk, press the **Delete** key until the disk name no longer appears in the Adaptec Array # box.

When you have selected the number of disks you specified in step 6, the next screen appears automatically.

8 If the array is mirrored or RAID 5 *and* you have a disk left, a prompt appears, asking whether you want to choose a spare disk:

If you do not want a spare: Type n and continue with step 9.

To select a spare: Follow these steps:

a At the prompt, type y.

b If more than one disk is available, a second prompt appears, asking how many spares the array will have. Type the number (1 or 2), and press **Enter**.

c To select each spare, follow the directions given in step 7. When you have selected the specified number of spares, the Selection List menu reappears automatically.

Note: A spare must have at least the capacity of the smallest disk in the array.

9 To add another array, select the array from the Selection List menu, then repeat steps 4 through 8.

10 When you have finished defining arrays and you are back at the Selection List menu, press **Esc**. Either the System Configuration menu or the Config menu appears (the menu you see depends on the menu you started from in step 1).

11 Format the array as described in Chapter 4, *Formatting Arrays*.

Modifying an Array

You can modify an existing array by changing the RAID level, by changing the disks in the array, or by adding or changing a spare disk. If you change the disks or the RAID level, you must format the array after you configure it (for instructions, see Chapter 4, *Formatting Arrays*). If you only add or change a spare disk, you need not reformat the array.

Changing the RAID Level

To convert from RAID 0 CVT to RAID 5 CVT or from RAID 5 CVT to RAID 0 CVT, see *Converting between RAID 0 CVT and RAID 5 CVT Formats* on page 7-7. You do not lose data if you convert between RAID 0 CVT and RAID 5 CVT formats.

To change an array to any other RAID level, first make sure the number of disks in the array is suitable for the new level (see *Number of Disks in an Array* on page 1-3). If it is, you can change the RAID level simply by reformatting the array for that RAID level. For formatting instructions, see Chapter 4, *Formatting Arrays*.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Caution: Make sure your data is backed up before you reformat the array!

If the number of disks in the array is not suitable for the new RAID level, you must reselect disks for the array and then format the array. For instructions on selecting disks, see the next section, *Selecting Different Disks for the Array*. For formatting instructions, see Chapter 4, *Formatting Arrays.*

Selecting Different Disks for the Array

The procedure for changing the disks in an array is similar to that for adding a new array. The main difference is that you must restart the server after you change the disks in an existing array. With a new array, you need not restart the server.

Follow these steps to select different disks for an array:

1. From the System menu or the Main menu, select **Change Array Configuration**.
2. Select **Redefine Array**. The Selection List menu appears, listing all possible arrays—defined or undefined. If you highlight an existing array, information on its configuration appears to the right of the Selection List menu, as illustrated in Figure 7-1.
3. Select the array you want to change.
4. Follow steps 4 through 10 in *Adding an Array*, beginning on page 7-2.
5. Exit the Administrator utility.
6. Restart the server.
7. Restart the Administrator utility.
8. Format the array as described in Chapter 4, *Formatting Arrays.*

Adding a Spare Disk

If you create a mirrored or RAID 5 array without spare disks (RAID 0 arrays never have spares), you can add up to two spare disks later. Spare disks are activated automatically if a disk in the array fails.

Follow these steps to add a spare disk to an array:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu, select the array to which you are adding spares. The Main menu for that array appears.
2. From the Main menu, select **Change Array Configuration**.
3. Select **Add Spare Drives**.
4. If you can add more than one spare, you are prompted to enter the number of spares you want to add. Type the number (1 or 2) and press **Enter**.

   The Administrator utility scans for drives on the host adapter used for that array, then displays the screen shown in Figure 7-2.
5. Press **Tab** to highlight the channel with the spare disk(s). The disks on the highlighted channel appear in the SCSI IDS on Channel menu. Select each spare disk by pressing the ↑ and ↓ keys until the disk name is highlighted, and then pressing the **Insert** or **Enter** key. The names of selected disks appear to the right, in the Adaptec Array # box.

Note: Remember, a spare must have at least the capacity of the smallest disk in the array.

6. When you have finished selecting spares, press **Esc**. A prompt asks you to confirm you are satisfied with your selections.
7. Type y to accept the new spare disks, or n to reselect the disks.
8. If you type y, an onscreen message notes that reconfiguration is complete.
9. Restart the server to have it recognize the new spares.

Deleting or Changing a Spare Disk

To delete a spare disk from an array, redefine the array as described in *Selecting Different Disks for the Array* on page 7-5. When the prompt asks if you want to choose spares, type n (no).

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-6
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

To use a different disk as the spare disk, you must also redefine the array. When the prompt asks if you want to choose spares, type y (yes); then select the new spare(s).

In both cases, you need not reformat the array.

Converting between RAID 0 CVT and RAID 5 CVT Formats

The RAID 0 CVT and RAID 5 CVT formats are the same as the RAID 0 and RAID 5 formats, but you can convert a RAID 5 CVT array to a RAID 0 CVT array and back again without loss of data and without reformatting. This feature is useful when you need to write a large quantity of data to a RAID 5 array—for example, if you are restoring data from tape to the array. If the array uses the RAID 5 CVT format, you can convert it to the RAID 0 CVT format before you begin writing the data. With its high write performance, the RAID 0 CVT format allows you to transfer the data more quickly. Once the data is transferred, you can convert back to the safer (that is, fault-tolerant) RAID 5 CVT format.

Note: If you convert a RAID 5 CVT array with spares to a RAID 0 CVT array, the RAID 0 CVT array retains the spares, but they are not usable. When you convert the array back to a RAID 5 CVT array, the spares can again be used.

To convert between formats, follow these steps:

1. If the system has only one array, skip to step 2. Otherwise, from the System menu select the array you want to convert. The Main menu for that array appears.
2. From the Main menu, select **Convert RAID Level**. The Convert menu appears.
3. Select **Convert to RAID 0 CVT** or **Convert to RAID 5 CVT**. The Configuration Overview screen appears, showing the current configuration of the array. At the bottom of the screen, the prompt Enter background priority (0-9) appears.
4. Indicate the priority by typing a number from 0 through 9 (0 assigns it the lowest priority; 9, the highest). Another prompt appears, asking you to confirm you want to continue.

5 To continue, type y; otherwise, type n.

If you are converting from RAID 0 CVT to RAID 5 CVT, the Configuration screen for the array appears. A message on the second line indicates the percentage of the conversion that is complete. If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main menu, and then selecting **Display Array Drive Status**.

The Convert utility also tracks RAID 0 to RAID 5 conversions, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt-Esc** until the status bar appears.

Note: Status screens are not shown for conversions from RAID 5 CVT to RAID 0 CVT, because the conversions are instantaneous.

Canceling a Conversion

You can cancel a conversion while it is under way, using either of the following procedures:

- From the Convert menu, select **Abort Convert**.
- At the status bar screen, press **Esc**. From the menu that appears, select **Abort**.

An onscreen message confirms that the conversion was aborted.

Changing the Priority of a Conversion in Progress

If a conversion is slowing other server operations unacceptably, you can lower the priority of the conversion on the server. You can speed a conversion by increasing its priority.

Change the priority at either the Convert menu or at the screen showing the status bar:

- From the Convert menu, select **Change Priority**. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-8
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

- From the status bar screen, press **Esc**. From the menu that appears, select **Change Priority**. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

The conversion continues automatically, running at the new priority.

Deleting Arrays

In systems with only one array, you use the De-install Array NLMs option to delete the array. In systems with multiple arrays, you can delete arrays singly by using the Delete an Array option. To remove all arrays at once, you use the De-install Array NLMs option. This section describes both options.

Caution: Before you delete an array, back up any data you want to keep. When you delete the array, all array data will be lost!

Deleting a Single Array in Multiple-array Systems

If the system has multiple arrays, follow these steps to delete a single array:

1. From the System menu, select **Change Array Configuration**. The System Configuration menu appears.
2. Select **Delete an Array**. A menu of arrays appears.
3. Select the array you want to delete. A prompt asks you to confirm that you want to delete the array.
4. Type y to delete the array, or n to cancel the operation.
5. Restart the server.

The disks can now be used as standard NetWare drives.

Deleting the Only Array or All Arrays

To delete the system's only array or to delete all arrays on a server, you must remove from the *startup.ncf* and *autoexec.ncf* files all

references to the NetWare loadable modules (NLMs). Follow these steps:

1. From the System menu (if you have multiple arrays) or the Main menu (if you have a single array), select **Change Array Configuration**.
2. Select **De-install Array NLMs**. A prompt asks you to confirm that you want to remove the NLMs.
3. Type y to remove the NLMs, or n to cancel the operation.
4. Restart the server.

The disks in all arrays revert to their previous status as individual disks.

Note: If you use De-install NLMs, you can later set up new arrays by following the procedure in *Creating the Initial Arrays* on page 3-1.

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 7-10
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

8

Working from a Remote Workstation

Adaptec CI/O software lets you monitor SCSI subsystems, including arrays, from a remote workstation. You can also use Adaptec CI/O to access the Administrator utility from a remote workstation. The Adaptec CI/O documentation explains the capabilities of Adaptec CI/O and provides instructions for using it. This chapter summarizes the capabilities that pertain to arrays and explains how to set up Adaptec CI/O to work with the Administrator utility.

Note: If you do not have Adaptec CI/O and would like information about this product, call Adaptec at the sales information number listed on page ii.

Standard Adaptec CI/O Features

Adaptec CI/O gives you the following capabilities:

- You can view and create maps of SCSI subsystems, including arrays, as illustrated in Figure 8-1.
- You can view charts of system performance.
- You receive alarms that notify you of changes in device status. When an alarm occurs, an Alarm icon appears on the system map. The alarms are also stored both in an alarm log and in a database, which you can use to generate reports. You can

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 8-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

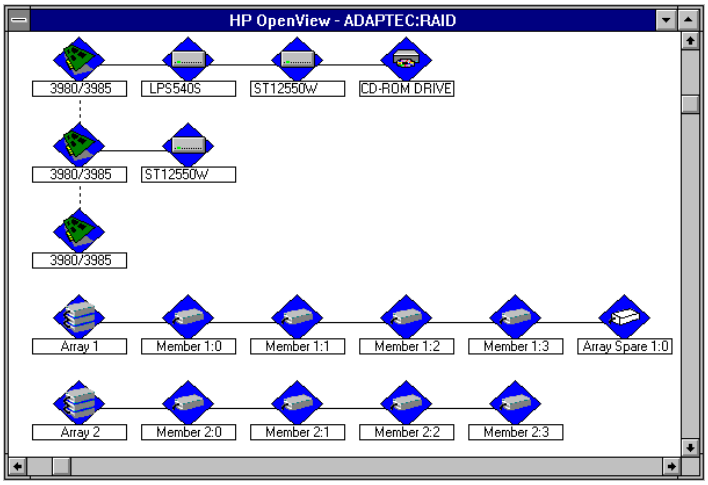

Figure 8-1. Adaptec CI/O software lets you remotely view array maps, such as this one, and other array information

configure an alarm to trigger an action, such as starting a program or activating a remote paging device.

For more information on the capabilities of Adaptec CI/O, see the Adaptec CI/O documentation.

Adaptec CI/O Features When Working with the Administrator Utility

When enabled to work with the Administrator utility (see the next section), Adaptec CI/O gives you the following additional capabilities at client workstations:

- You can remotely access the Administrator utility, allowing you to perform any Administrator utility function at the workstation.
- You receive the following messages generated by the Administrator utility: Down Drive, Array is Critical (indicates the array will fail if another drive fails), Drive Up, Array Offline, Array Fault Tolerant, Reconstruct Failed, Using the Spare (indicates the spare has been activated), Spare Has Been Added.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 8-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

- You can create an Adaptec CI/O submap that displays the following array information: RAID level, number of drives, and number of spares. For information on submaps, see the Adaptec CI/O documentation.
- You can use the SCSI I/O Monitor to display the following array performance data: Array status (fault-tolerant, critical, or off-line), number of combined scatter/gather requests, number of scatter/gather writes, total sectors written, total sectors read, number of read and write requests from the operating system, and errors detected when the array was verified. For information on the SCSI I/O Monitor, see the Adaptec CI/O documentation.

Enabling a Remote Workstation to Receive Administrator Utility Data

To receive the Administrator utility data at a remote workstation, you must take the following steps:

1. At the remote workstation: Install Adaptec CI/O. See the Adaptec CI/O documentation for instructions.
2. At the server:
   a. Enter the following command in the *autoexec.ncf* file:

      load snmp (insert this command just *before* the line containing load arumon)

   b. If the server includes Adaptec host adapters other than the AHA-3980 or AHA-3985, or if drives on a AHA-3980 or AHA-3985 are not included in an array, also add this line to the *autoexec.ncf* file:

      load cio (insert this command just *after* the line containing load arumon)

   c. Start the Administrator utility.

Remotely Accessing the Administrator Utility

To access the Administrator utility from within Adaptec CI/O, follow these steps:

1. Click on the **Remote Console** button on the CI/O toolbar. This opens a Novell NetWare RConsole window, which lists the servers.
2. Select the name of the server where the Administrator utility is installed.
3. When prompted, enter your log-in name and password. You must have supervisory privileges.
4. When the RConsole prompt appears, enter the following command:

   ```
   load aruadmin
   ```

The Administrator utility starts. You can now use it as described in this manual.

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: 8-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

A

Error Messages

This appendix describes the error messages displayed by the Adaptec array software, explains the probable cause of the error, and suggests remedies. The error messages are listed in alphabetical order.

A SCSI Inquiry command failed.
A SCSI Mode Select command to a drive in the disk array failed.
A SCSI Mode Sense command to a drive in the disk array failed.
During formatting, the formatting utility issues these SCSI commands to all drives. If you receive one of these messages, a drive did not respond to the command. Check the power and cable connections for the drives. If a drive still does not respond, it is probably bad. Replace it and try formatting again.

Adaptec array command *n* failed.
The array driver *ardrvr.dsk* may not be loaded. Load *ardrvr.dsk* and try again.

Adaptec array load line in the STARTUP.NCF file is incorrect.
An array load line in the *startup.ncf* file contains incorrect information or does not follow the format for an array load line (this may happen if you attempt to create or edit an array load line by editing the *startup.ncf* file directly). Delete the load line from the *startup.ncf* file, then use the Administrator utility to create a new array that meets your specifications (see *Adding an Array* on page 7-1). The Administrator utility will automatically enter a correctly formatted load line in the *startup.ncf* file.

Adaptec thread creation failed.
This message indicates problems with the operating system. Contact Adaptec Technical Support.

An AUTOEXEC.NCF file must be created before running this utility.
The utility could not find the array monitoring utility, *arumon,* which must be loaded at all times (see *arumon.nlm* on page B-3). Edit the server's *autoexec.ncf* file by adding the following line at the end of the file:

```
load arumon
```

Save the change and then restart the server. NetWare will now load *arumon* automatically whenever the server starts.

Attempt to obtain Adaptec driver version failed.
An array utility tried to obtain the version number of the Adaptec array driver (*ardrvr.dsk*) but was unable to do so—probably because the driver is not loaded. Load *ardrvr.dsk* and try again.

Command line argument #*n* invalid.
The Administrator utility tried to load another utility, but was unable to do so. Call Adaptec Technical Support.

Could not find an Adaptec array driver load line in STARTUP.NCF.
The *startup.ncf* file does not include a load line for an array. To create a load line, create an array (see *Creating the Initial Arrays* on page 3-1).

DOS must be in memory so that STARTUP.NCF can be modified.
You tried to start an array utility when DOS was unloaded. Restart the server and do *not* remove DOS, then restart the utility.

Encountered a problem loading an NLM. Installation may be incomplete.
This message appears when the Administrator utility installs the array utilities in *sys:system* and a required file does not load. Recopy the files from the *c:\aha398x\netware* directory to the DOS directory containing the *server.exe* file (see *Copying the Driver Files* in Chapter 4 of *AHA-3980/3985 User's Guide*); then use the Install Utility Suite option to re-install the utilities (see *Installing the Array Utilities in the sys:system Directory* on page 3-6).

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: A-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Failed to open Adaptec drive definition file.
The utility could not read or find the file *arudrv.def*. Recopy the file from the AHA-3980/3985 Drivers and RAID Utilities disk; then restart the Administrator utility.

Host adapter number in the STARTUP.NCF file is invalid.
An array load line in the *startup.ncf* file contains an invalid host adapter ID. Delete the load line from the *startup.ncf* file, then use the Administrator utility to create the array (see *Adding an Array* on page 7-1). The Administrator utility will automatically enter the correct IDs in the *startup.ncf* file.

Invalid Adaptec disk array model number of *n* for command *m*.
Call Adaptec Technical Support.

Invalid command error received from the Adaptec disk array driver.
This indicates a software problem. Call Adaptec Technical Support.

Invalid number of drives specified in STARTUP.NCF file.
You tried to modify an array by editing the array load line in the *startup.ncf* file, but the number of drives you entered is invalid for the array type (see *Number of Disks in an Array* on page 1-3). The surest solution is to delete the load line altogether, then use the Administrator utility to create a new array that meets your specifications (see *Adding an Array* on page 7-1). The Administrator utility will prevent you from making incorrect selections.

I/O error occurred on array #*n* during Convert. Conversion aborted.
I/O error occurred on array #*n* during Reconstruct. Reconstruct aborted.
I/O error occurred on array #*n* during Verify. Verification aborted.
The utility was unable to convert, reconstruct, or verify the array. Try the procedure again. If it still fails, call Adaptec Technical Support.

Multiple drives in load line have same parameters.
An array load line in the *startup.ncf* file specifies the same drive twice. Delete the load line from the *startup.ncf* file, then use the Administrator utility to create the array (see *Adding an Array* on page 7-1). The Administrator utility will automatically enter the correct drive information in the *startup.ncf* file.

No current broadcast string found.
The *aru.ini* file does not include the necessary broadcast information. Determine whether the file exists or is corrupted. If the file does not exist, unload then reload *arumon*. This should create the file. If the file is corrupted, call Adaptec Technical Support.

No device error received from the Adaptec disk array driver.
The utility is not working properly. Call Adaptec Technical support.

No drives specified in STARTUP.NCF file.
You created an array load line in the *startup.ncf* file, but did not specify the drives for the array. Delete the load line altogether, then use the Administrator utility to create a new array that meets your specifications (see *Adding an Array* on page 7-1). The Administrator utility will automatically enter a correctly formatted load line in the *startup.ncf* file.

Not enough drives to configure any RAID level.
You tried to create a new array, but there is only one drive left. For the minimum number of drives in each array type, see *Number of Disks in an Array* on page 1-3.

Not enough memory to run this utility!
The system memory is already allocated to other utilities. Unload some of these utilities to free up memory, or install more memory.

SCSI ID in the STARTUP.NCF file is invalid.
An array load line in the *startup.ncf* file contains an invalid SCSI ID. Delete the load line from the *startup.ncf* file, then use the Administrator utility to create the array (see *Adding an Array* on page 7-1). The Administrator utility will automatically enter the correct IDs in the *startup.ncf* file.

Spare for array #*n* not activated - STARTUP.NCF not accessible.
The Administrator utility tried to activate a spare, but was unable to modify the *startup.ncf* file to place the spare in the array load line. This means DOS is not loaded. Restart the server and do *not* remove DOS, then restart the Administrator utility.

The drive is too small for reconstruction.
The reconstructed data cannot fit on the replacement drive. Use a larger capacity drive.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: A-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

The Format command failed on drive #*n*.

This message can appear during formatting or drive reconstruction. Check the power and connections to the drive, then retry the procedure. If the message still appears, the drive is probably bad. Replace the drive and try the procedure again.

The Read Capacity command for drive #*n* failed.

During formatting, the formatting utility issues a SCSI Read command to all drives. If you receive this message, a drive did not respond to the command. Check the power and cable connections for the drives. If a drive still does not respond, it is probably bad. Replace it and try formatting again.

The SCSI Read Capacity command for spare #*n* failed.

You are formatting or reconstructing a disk that has failed or that cannot be found. Verify that the drive is turned on and check all connections. If this does not resolve the problem, replace the disk.

This Adaptec utility is incompatible with the Adaptec disk array driver.

You either updated the Adaptec array driver *ardrvr.dsk* without reinstalling (updating) the other Adaptec array files, or updated the utility NLMs without updating the driver. Copy the updated Adaptec array software from the diskette to the server directory that contains *server.exe*, then use the Install Utility Suite option to install the updated software (see *Installing the Array Utilities in the sys:system Directory* on page 3-6).

This NLM is not executable from the command line.

You cannot run this utility from the command line. You must use the Administrator utility.

Unable to convert the array.

An I/O error occurred during the conversion. Check the power and cable connections for all array drives, then try the conversion again.

Unable to find a DOWN drive that responds to Test Unit Ready.

You are trying to reconstruct data on a drive that was down, but the drive is not responding. Either the drive is not installed or it is still down. Install or replace the drive and try again.

Unable to obtain Adaptec array state.

The utility tried to determine the status of the array, but was unable to do so—most likely because the *startup.ncf* file does not include a load line for the array (see *The startup.ncf and autoexec.ncf Files* on page 3-7). Reinstall the array, following the instructions in *Adding an Array* on page 7-1.

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: A-6
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

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Glossary of Array Software

Read this appendix for an overview of

- NetWare drivers used by the arrays
- NetWare loadable modules used with the arrays
- Other files associated with the Adaptec array software

NetWare Drivers

ardrvr.dsk

The array driver, which makes the array disks appear to the server as a single virtual disk and controls array operations. The driver uses the information you enter with the Administrator utility (component disks, RAID level) to set up and operate the array.

When you create an array, the Administrator utility automatically adds a load line for *ardrvr.dsk* to the *startup.ncf* file. Each array has a separate *ardrvr.dsk* load line. For more information on the load line, see *The startup.ncf and autoexec.ncf Files* on page 3-7.

mcim.dsk

The interface between *ardrvr.dsk* and the AHA-3980 or AHA-3985. This driver loads automatically when *ardrvr.dsk* loads.

NetWare Loadable Modules

aruadmin.nlm
The Administrator utility, which allows central control of all array tasks, including the following:

- Setting up the initial arrays
- Displaying the status and configuration of arrays
- Verifying mirrored and RAID 5 arrays
- Testing spare drives
- Reactivating an off-line array or spare
- Reconstructing data on replacement drives
- Converting a RAID 5 array to RAID 0, or vice versa
- Adding, redefining, or deleting an array
- Scheduling Verify, Reconstruct, and Spare Test operations

The Administrator utility gives the operator a visual tool for building the appropriate array load line in the *startup.ncf* file. It also inserts the *arumon.nlm* load line in the *autoexec.ncf* file, ensuring the Array Monitor utility loads whenever the server starts.

The Administrator utility loads other utilities, such as *arucvt* (the Convert utility), as needed.

arucvt.nlm
The Convert utility, which runs the RAID conversion function for *aruadmin*. Depending on the operator's selection, *arucvt* converts RAID 0 CVT arrays to RAID 5 CVT arrays or vice versa.

arufmt.nlm
The Format utility, used to format the arrays for the RAID level specified by the operator. This utility is used for the formatting function in *aruadmin*.

arulib.nlm
The library of routines used by all array NLMs. This file loads automatically when the first array file (usually *arumon.nlm*) loads.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: B-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

arumon.nlm
The Array Monitor utility, which performs the following functions:

- Monitors the array driver for error conditions and displays the error messages on the server console. The messages are also broadcast to any client locations selected by the operator.
- Automatically starts the Reconstruct utility (*arurec.nlm*) if a drive fails in an array that contains a spare.
- If a function is scheduled, loads the Scheduler utility (*aruschedd.nlm*) when the server starts.

The Array Monitor utility must be loaded at all times and only one instance may be loaded. When you set up the initial arrays on a server, the Administrator utility automatically inserts the load line for *arumon.nlm* in the *autoexec.ncf* file, ensuring the Array Monitor utility loads whenever the server starts.

arurec.nlm
The Reconstruct utility, which runs the data reconstruction function for *aruadmin* and *arusched*. In mirrored arrays, this utility remirrors one or all down drives. In RAID 5 arrays, the utility uses parity and user data on the good drives to reconstruct data on a down drive.

arusched.nlm
The Scheduler utility, which performs Verify, Reconstruct, and Spare Test operations scheduled by *aruadmin*. If an operation is scheduled, *arumon* loads the Scheduler utility when the server starts. The Scheduler utility sleeps until the scheduled time of the operation.

aruver.nlm
The Verify utility, which runs the array verification function for *aruadmin* and *arusched*. This utility verifies the consistency of data on mirrored and RAID 5 arrays.

Other Files

aru.ini
A text file that contains the following configuration information:

- Monitor type: Color or monochrome. The default is *C* (color).
- Persons who will receive broadcast messages: The default is *Everybody*.

- Scheduling information: The scheduled times for verifications, spare tests, or reconstruction of data on a replacement disk
- Auto-Correct flag for the Verify function: The default is *Y* (that is, Auto-Correct is on). For information on the Auto-Correct flag, see *Verifying Arrays* on page 6-1.
- Low-level format flag for the Reconstruct function: The default is *N (*that is, no low-level format is performed as part of the Reconstruct function).

If you accidentally delete the *aru.ini* file, you can re-create the file by restarting the server. When the Array Monitor utility loads, it automatically creates the *aru.ini* file (if it does not exist), setting the parameters to their default values. Use the Administrator utility to reschedule verifications or other tasks, and to select those who will receive broadcast messages. The information is automatically stored in the new *aru.ini* file.

aru.log
A data file, created the first time *arumon.nlm* loads, that contains error messages, start and completion times for functions, and noteworthy messages. All array modules write to this file.

aru.msg
The message file, a compressed ASCII file that contains all text displayed on screen.

arudrv.def
The drive definition file, which contains format information for drives of various manufacturers. This information is used by the Format utility (*arufmt.nlm*).

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: B-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

C

Menu Reference

The figures on the following pages show the primary menu options for the Administrator utility. The first figure illustrates the System menu, which is the first menu that appears in systems with multiple arrays. The second figure illustrates the Main menu, which is the first menu in systems with only one array. The Main menu also appears when you select an array from the System menu.

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: C-1
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: C-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

SYSTEM MENU

(the first menu that appears in systems with multiple arrays)

- **Select Adaptec Array #1**
  - Main Menu for Array #1 (see Main Menu on next page)
- **Select Adaptec Array #2**
  - Main Menu for Array #2 (see Main Menu on next page)
- **Select Adaptec Array #3**
  - Main Menu for Array #3 (see Main Menu on next page)
- **Select Adaptec Array #4**
  - Main Menu for Array #4 (see Main Menu on next page)
- **Display Array Status**
  - Display Array Overview
  - Display Array Drive Status
- **Change Array Configuration**
  - Add an Array
  - Add Spare Drive(s)
  - Redefine an Array
  - Delete an Array
  - Change Message Repeat Cycle
  - Change Broadcast Mode
  - De-install Array NLMs
  - Install Utility Suite

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Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: C-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

MAIN MENU FOR ARRAY #_
(the first menu that appears in systems with only one array)

- **Display Array Status**
  - Display Array Overview
  - Display Array Drive Status
  - Display Statistics
    - Temporary Array Statistics
    - Temporary Drive Statistics
    - Permanent Drive Statistics
    - Reset Temporary Statistics
    - Set Sampling Rate
    - Log Current Data Values
- **Verify Functions**
  - Start Verify
  - Change Priority
  - Abort Verify
- **Reconstruct Functions**
  - RAID5 Reconstruct
  - Re-mirror Single Drive
  - Re-mirror All DOWN Drives
  - Change Priority
  - Abort Reconstruct
- **Format Array**
  - RAID0 Format
  - RAID5 Format
  - Mirror Format
  - RAID0 CVT Format
  - RAID5 CVT Format
- **Convert RAID Level**
  - Convert to RAID 0 CVT
  - Convert to RAID 5 CVT
  - Change Priority
  - Abort Convert
- **Change Array Configuration**
  - Add an Array
  - Add Spare Drive(s)
  - Redefine an Array
  - Change Message Repeat Cycle
  - Change Broadcast Mode
  - De-install Array NLMs
  - Install Utility Suite
- **Scheduler Functions**
  - Schedule Verify
  - Unschedule Verify
  - Schedule Reconstruct
  - Unschedule Reconstruct
  - Schedule Spare Testing
  - UnSchedule Spare Testing
- **Reactivate Off-line Array**
- **Reactivate Spare**
- **Hardware Functions**
  - Display Host Adapter Drives
  - Blink Drive Lights
  - Hot Swap Pause

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A
Print Spec Number: 493069-00
Current Date: 3/3/99
Page: C-5
ECN Date: 3/28/95

▼▼▼▼ Index

A

Adaptec Array Software
  See also Administrator Utility
  glossary of files B-1–B-4
  overview of 1-4
  system requirements 1-5
Adaptec BBS iv
Adaptec CI/O Software 8-1–8-4
  overview of 1-5
  remotely accessing the Administrator utility 8-4
  special features through the Administrator Utility 8-2
  standard features 8-1
  system requirements 1-6
Adaptec FTP Server iv
Adaptec WWW Server iv
Add an Array Option 7-1
Add Spare Drives Option 7-6
Adding Arrays 7-1–7-4
Administrator Utility
  basics 2-1–2-5
  exiting the utility 2-2
  getting help 2-5
  gray menu options 2-5
  Main menu 2-2
  selecting menu options 2-4
  starting the utility 2-1
  System menu 2-2, 2-4
AHA-3980 or AHA-3985 Menu 3-4
Array Monitor Utility 3-7
Array Types
  mirrored 1-2
  RAID 0 (striped) 1-2
  RAID 0 CVT 1-3
  RAID 1 1-2
  RAID 1/0 1-2
  RAID 5 1-2
  RAID 5 CVT 1-3
  reference document 1-3
Arrays
  adding an array 7-1, 7-4
  adding spares 7-5
  changing RAID level 7-4
  converting formats 7-7–7-9
  definition in *startup.ncf* file 3-7
  deleting arrays 7-9–7-10
  deleting spares 7-6
  formatting 3-6, 4-1, 4-4
  identifying 6-10
  initial setup 3-1–3-7
  modifying 7-4–7-7
  monitoring 5-1–5-7, 8-1–8-4
  number of disks in 1-3
  performance statistics 5-3
  reactivating an off-line array 6-7
  reactivating spare disks 6-7
  reconstructing data 6-4–6-7
  remote management 8-1–8-4
  remote monitoring 8-1–8-4
  scheduling tasks 6-8–6-9
  selecting different disks 7-5
  selecting different spares 7-6
  selecting disks for 3-4
  selecting RAID level 3-2
  selecting spares for 3-5
  selecting the host adapter 3-3
  status of arrays 5-2
  verifying arrays 6-1–6-4
aru.ini File 6-3, B-3–B-4

aru.log file 5-4, 5-7
arubcast.lst file 5-6
arumon Utility 3-7
Auto-Correct Option 6-3, B-4
autoexec.ncf file 3-7

B

Blink Drive Lights Option 6-11
Block Size
  See Data Block Size
Broadcast Modes Menu 5-6
Broadcasting Array Status
  arubcast.lst file 5-6
  messages broadcast 5-5
  repeat interval for messages 5-7
  who receives broadcasts 5-5–5-7

C

Cables
  See SCSI Cables
Change Array Configuration Option 7-1
Change Broadcast Mode Option 5-6
Change Message Repeat Cycle Option 5-7
CI/O Software
  See Adaptec CI/O Software
Conventions 1-7
Conversion Status Bar 7-8
Convert Menu 7-7
Convert RAID Level Option 7-7
Converting between RAID 0 and RAID 5 7-7–7-9
  canceling a conversion 7-8
  changing the priority of conversions 7-8
  spares, disposition of 7-7
  tracking conversions 7-8
Customer Support
  See Technical Support

D

Data Block Size 4-2
Data Sampling Rate
  changing 5-3
  default rate 5-3
De-install Array NLMs Option 7-10
Delete an Array Option 7-9
Deleting Arrays 7-9–7-10
  deleting a single array in a multiple-array system 7-9
  deleting all arrays 7-9
  deleting the only array 7-9
Disks
  identifying their place in array 6-10
  locating by blinking drive light 6-11
  number of disks allowed 1-3
  replacing in drive enclosure 6-12
  selecting array disks 3-4
  using disks from different manufacturers 1-4
  using disks with different capacities 1-4
Display Array Drive Status Option 5-2
Display Array Overview Option 5-2
Display Array Status Option 5-2
Display Host Adapter Drives Option 6-10
Drive Selection Screen 3-3

E

Error Messages A-1–A-6

F

F1 Key 2-5
Formatting Arrays 4-1–4-4
  canceling formatting 4-4
  data block size 4-2
  formatting method 4-1

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: Index-2
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

initialization 4-1
low-level formatting 4-1
tracking progress 4-3

H

Hardware Functions Option 6-10
Help, Getting 2-5
Highlight Bar Problems 2-4
Hot Swap Pause Option 6-12

I

Initialization
advantages and disadvantages as formatting method 4-1
steps for 4-2
Installing the Array Software
installing the RAID utilities in *sys:system* 3-1, 3-5, 3-7

L

Load Line 3-7
Log Current Data Values Option 5-4
Log File 5-4, 5-7
Low-level Formatting
advantages and disadvantages 4-1
steps for 4-2

M

Main Menu 2-2–2-4
Menu Options
Add an Array 7-1
Add Spare Drives 7-6
Blink Drive Lights 6-11
Change Array Configuration 7-1
Change Broadcast Mode 5-6
Change Message Repeat Cycle 5-7
Convert RAID Level 7-7
De-install Array NLMs 7-10
Delete an Array 7-9
Display Array Drive Status 5-2
Display Array Overview 5-2
Display Array Status 5-2
Display Host Adapter Drives 6-10
Hardware Functions 6-10
Hot Swap Pause 6-12
Log Current Data Values 5-4
Reactivate Off-line Array 6-7
Reactivate Spare Disk 6-7
Reconstruct Functions 6-5
Redefine Array 7-5
Reset Temporary Statistics 5-4
Scheduler Functions 6-8
Temporary Array Statistics 5-3
Temporary Drive Statistics 5-3
Verify Functions 6-2
Menus
getting help 2-5
gray options 2-5
menu reference trees C-1
selecting from 2-4
Messages
changing the repeat interval 5-7
list of broadcast messages 5-5
who receives messages 5-5–5-7
Mirrored Arrays
See RAID 1 Arrays or RAID 1/0 Arrays
Modifying Arrays 7-4, 7-7
adding a spare 7-5
changing disks 7-5
changing RAID level 7-4
deleting spares 7-6
selecting different spares 7-6
Monitoring Arrays 5-1–5-7
logical array characteristics 5-1, 5-2
performance statistics 5-1
physical array characteristics 5-1, 5-2
remote monitoring 8-1–8-4

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: Index-3
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

types of monitoring information 5-1
using Adaptec CI/O 8-1–8-4
Monochrome Monitor 2-4

O

Off-line Array, Reactivating 6-7

P

Pausing Host Adapter Activity 6-12
Performance Information 5-3
data sampling rate 5-3
permanent statistics 5-3
saving in the log file 5-4
temporary statistics 5-3, 5-4
viewing at server console 5-3
Permanent Statistics
defined 5-3
viewing at a remote workstation 8-1–8-3
viewing at server console 5-3
Priority of Background Operations, Explained 6-2

R

RAID 0 Arrays
data block size 4-2
described 1-2
number of disks in 1-3
RAID 0 CVT Arrays
converting to RAID 5 CVT 7-7–7-9
data block size 4-2
described 1-3
number of disks in 1-3
RAID 1 Arrays
data block size 4-2
described 1-2
number of disks in 1-3
spare disks 1-3
RAID 1/0 Arrays
data block size 4-2
described 1-2
number of disks in 1-3
spare disks 1-3
RAID 5 Arrays
data block size 4-2
described 1-2
number of disks in 1-3
spare disks 1-3
RAID 5 CVT Arrays
converting to RAID 0 CVT 7-7–7-9
data block size 4-2
described 1-3
number of disks in 1-3
spare disks 1-3
RAID Levels
changing 7-4
described 1-1
RAID Utilities
See Adaptec Array Software
Reactivate Off-line Array Option 6-7
Reactivate Spare Disk Option 6-7
Reactivating a Spare Disk 6-7
Reactivating an Off-line Array 6-7
Read Requests, Statistics on 5-3
Reassigned Blocks, Displaying 5-3
Reconstruct Functions Option 6-5
Reconstruct Menu 6-5
Reconstructing Data 6-4–6-7
canceling reconstruction 6-6
changing the priority of reconstructions 6-6
immediate reconstructions 6-5
scheduling reconstructions 6-6, 6-8–6-9
tracking reconstruction 6-5
Reconstruction Status Bar 6-6
Redefine Array Option 7-5
Remote Monitoring
See Adaptec CI/O

Creating and Managing Arrays
Stock Number: 510685-00, Rev. A Page: Index-4
Print Spec Number: 493069-00
Current Date: 3/3/99 ECN Date: 3/28/95

Replacing Disks in a Drive Enclosure 6-12
Reset Temporary Statistics Option 5-4

S

Scheduler Functions Option 6-8
Scheduler Menu 6-8
Scheduling Tasks 6-8–6-9
  canceling a schedule 6-9
  changing a schedule 6-9
  creating a schedule 6-8–6-9
SCSI IDs on Channel Menu 3-4
Selection List Menu 3-2
Spare Disks
  adding 7-5
  capacity of 1-4
  changing spares 7-6
  in conversions from RAID 5 CVT to RAID 0 CVT 7-7
  deleting 7-6
  reactivating 6-7
  selecting 3-5
  testing 6-4, 6-8–6-9
startup.ncf file 3-5, 3-7
Statistics
  See Performance Information
Status Information 5-1–5-3, 8-1–8-3
Status Menu 5-2
Status, Array
  broadcasting status messages 5-5–5-7
Stopping Host Adapter Activity 6-12
Striped Arrays
  See RAID 0 Arrays
sys:system Directory
  creating *sys:system* on an array 3-6
  installing the Adaptec utilities in 3-1, 3-5, 3-6–3-7
System Menu 2-2, 2-4
System Requirements
  hardware 1-5
  software 1-6

T

Technical Support iv
Temporary Array Statistics Option 5-3
Temporary Drive Statistics Option 5-3
Temporary Statistics
  defined 5-3
  resetting to zero 5-4
  viewing at a remote workstation 8-1–8-3
  viewing at server console 5-3
Typographic Conventions 1-7

V

Verify Functions Option 6-2
Verify Menu 6-2
Verify Status Bar 6-2
Verifying Arrays 6-1–6-4
  Auto-Correct option 6-3, B-4
  canceling verifications 6-3
  changing the priority of verifications 6-4
  how verification works 6-1
  immediate verification 6-2
  mirrored arrays 6-1
  RAID 5 arrays 6-1
  recording repaired blocks 6-3
  scheduling verifications 6-3, 6-8–6-9
  tracking verification 6-2
  with down disks 6-1

W

Write Requests, Statistics on 5-3

❒

Creating and Managing Arrays
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